

motion. We have reason to believe that it is transmitted by the ether that fills all space; but we do not know what ether is. Nevertheless, we seem at last to be on the verge of discovering something about ether, that greatest of all mysteries in physics.

Light travels one hundred and ninety thousand miles a second. We presume that it is transmitted by vibrations of ether. Electricity moves at exactly the same speed. What does this suggest? Plainly, it suggests that the same medium transmits both. In other words, we may fairly assume that electricity is transmitted by ether. The experiments of Hertz and other eminent physicists all show intimate relations existing between electricity and light. Indeed, it is not going too far to say that electricity may yet annex a large part of the domain of optics.

Is it not reasonable to imagine that within much less than a century from the present time we shall discover means whereby we can produce light by setting ether in motion? Wireless apparatus transmits messages over great distances by causing vibrations of ether; why should we not set it moving for the making of artificial daylight? When this problem is solved, we shall have an excellent counterfeit of daylight at our ready disposal. We can turn it on and flood a dwelling with it, or a great building, in an instant. Perhaps it may not be cheap enough to illuminate a city; though some cities, such as Cleveland and Detroit, have already tried to produce imitation moonlight by uplifting powerful arc lights on lofty poles.

Let us consider another possibility. When two different metals are soldered together, and heat is applied to the point of joining, electricity is produced. That is to say, the heat is converted into electricity direct, without the intervention of a steam engine. Different pairs of metals may be used for the purpose; but the two best, yielding the greatest amount of electricity in proportion to the heat consumed, are bismuth and antimony.

It appears, then, that we have here the germ of a practical solution of a much vexed problem. Physicists and engineers all over the world have been racking their brains to find a means whereby electricity could be obtained directly from heat. This accomplishes the feat—the trouble being that it works only on a very small scale. Nevertheless, it is possible by this means, taking a number of pairs of metals, to make a battery and get a current; enough current, that is to say, for a small installation.

How shall we find a way to accomplish the same result economically on a large scale, making electricity in great quantities from heat direct, at low cost? It is the biggest of all questions from the viewpoint of the electric engineer. If we knew what heat was, and what electricity was, it might be comparatively easy to discover a means for transforming one into the other; but we don't know either of these things. Our understanding of the matter is that both are forms of motion. The problem is to convert heat motion into electric motion.

The Home's Future

WE are bound to solve it some day, perhaps before very long. Our descendants a century from now will surely have worked it out. If we could enjoy the privilege of walking into one of their houses and looking about us, we might see at least one thing that would attract our attention as a novelty. In its simplest form, it might be nothing but a sort of pot hanging in a corner of the kitchen, with an alcohol burner beneath it, and a couple of wires emerging from some kind of fluid inside.

The owner of the house might thereupon explain that this simple apparatus produced all the electricity required for illuminating the dwelling, for the cooking, and for running the family sewing machine. Made somewhat larger, and with suitable modifications, it would heat the house. Provided with such an outfit, the householder is independent of the coal merchant and the gas company. All the conditions of living are revolutionized by the cheap and practical electric furnace. The Electrical Age has at length arrived.

Be it understood that one electric furnace, conveniently placed in kitchen or cellar, illuminates and warms the entire dwelling, and heats the apparatus used for cooking purposes. An ordinary servant, no matter how ignorant or clumsy, is able to take care of it. Biddy does all that the great installations and high priced electrical engineers are able nowadays to do. She simply starts a fire, which produces electricity for every kind of employment. Wires pass from the central station (the furnace) to every room in the house,—to the chandeliers, to the fans (for summer use), and to the radiators. Even the machinery in the laundry is run by the current. There are no electric bills, and no bills for gas. The cost is nominal.

Indeed, the cost of the outfit and the expense of keeping it in operation will be so small that even the humblest home and the poorest family will have an independent electric plant. But think of the revolution accomplished in matters industrial by such a discovery! No more steam plants or dynamos. Electric motors will displace all other motors, save perhaps for flying machines. In factories, the great engines and huge boilers of today will be replaced by an electric furnace, with the requisite equipment of wires, and a motor for each machine. By the help of the steam engine, we now obtain from coal only five per cent. of the energy stored in such fuel; under the electric dispensation we shall obtain perhaps ninety-five per cent.

This implies enormous cheapening of cost of production, where manufactured articles are concerned. Great cheapening must come also from the simplification of plants, which will be applied wherever power is used for any purpose whatsoever. Necessarily, a cheapening of products will follow. Whatever we eat or wear, or use in any other way, will become cheaper.

The hotel will be no less a gainer by cheap electricity

than the private dwelling. In its cellar will be one huge electric furnace which, through a network of wires, will illuminate and heat the entire establishment, incidentally doing the cooking, ventilating the rooms, operating the refrigerating outfit, and running the laundry machinery.

In like manner, the department store and the great office building will be supplied with cheap current for all purposes; one very important advantage of electricity being that it can be readily handled and applied for every imaginable use. Even on the ocean, the transatlantic greyhound of a century hence may be driven by a single electric furnace, which will light the vessel, heat the cabins, cook the meals, and run the wireless apparatus.

Suggestion has been made of the possibility that at no very distant day—say, a century from now—means may be found whereby power can be transmitted over long distances by wireless for driving street cars and even railway trains. Such a thing may come to pass; it is theoretically conceivable, at all events. Yet my own imagination hardly carries me so far. In this brief discussion I am trying to confine myself to that which is not beyond the bounds of reasonable probability.

Among the lines along which electrical discovery seems likely to undergo important development is that of optics. To illustrate this remark, I may refer to the well known fact that an electric "field" will bend a ray of light. Thus it is that a light ray reflected from the polished pole of a magnet is twisted.

Now, let us see how this fact applies to the possible future development of the telescope. The pupil of the eye is one-fifth of an inch in diameter, and can grasp only a small amount of light. A twenty-five-inch object glass of a telescope enables the eye to take in over fifteen thousand times more light, and brings the moon to within an apparent distance of eighty miles. We could bring the moon and other celestial objects much nearer, of course, if we could make bigger lenses; but mechanical difficulties are in the way. Only after years of patient work by the most highly skilled experts can a

perfect twenty-five-inch glass be made; and even then the job is often a failure. Changes of structure due to jarring, or to unequal pressure, or to temperature, may ruin the result.

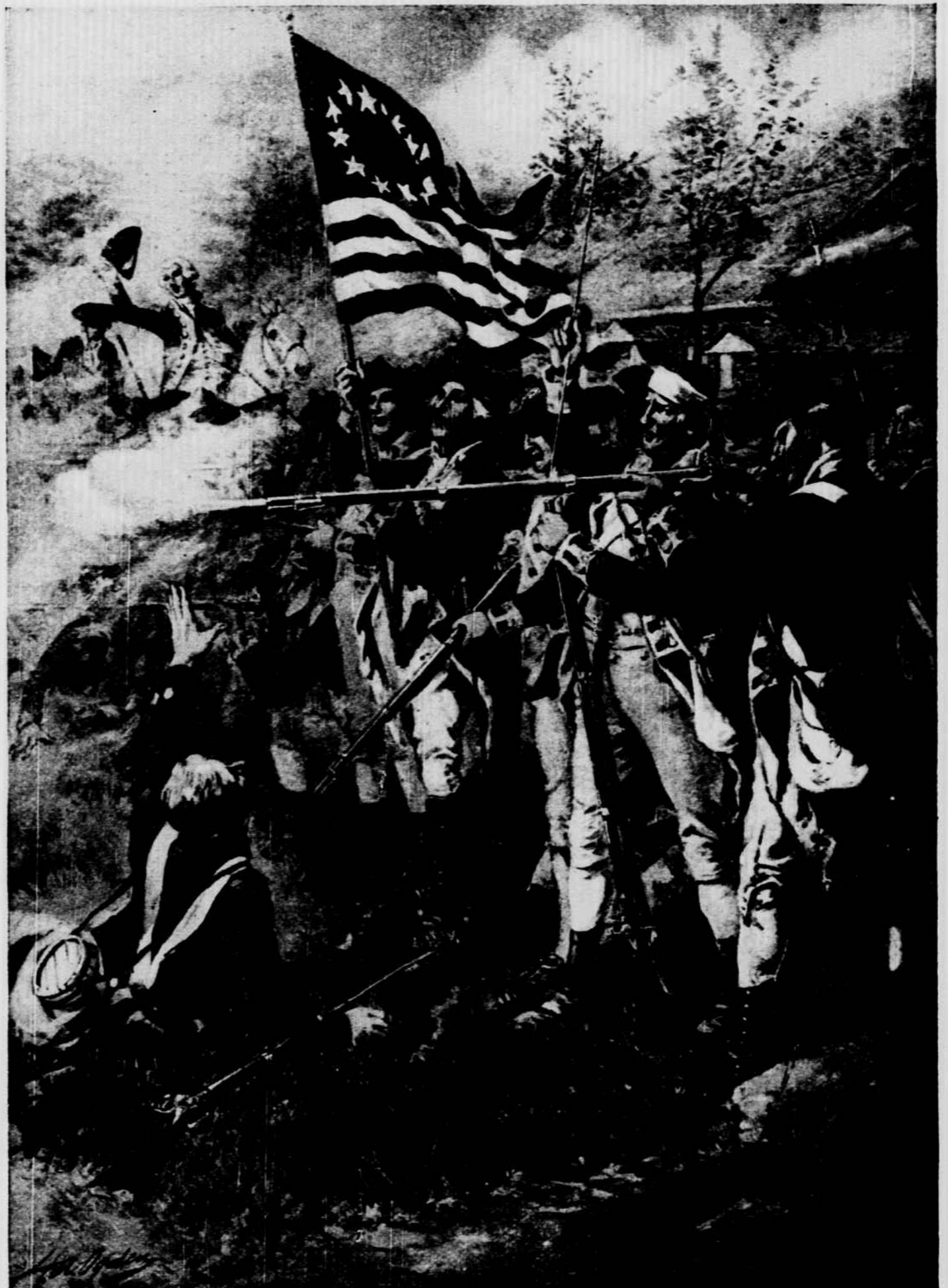
The glass is used for no other purpose than to bend the light rays, and to bring them to a focus at one point, so that the eye shall be able to grasp them. Why, then, might it not be practicable to do away with the glass entirely, and to replace it with a suitably arranged electric field? The answer is that this may yet be accomplished, when we have solved the theoretical problem involved. When we can do this, we may be able to arrange an electric field fifty feet in diameter, which will be better and more ideally accurate for focusing purposes than the most perfect glass lens of equal size imaginable—even supposing that such a lens could be made.

What then? Why, if this shall be done, we may be able, unless unexpected difficulties arise, to look upon the moon so close at hand as to discover the smallest details of its topography. We shall know almost as much about it (so far as the side it turns toward us is concerned) as if we were able actually to walk upon its surface. Nay, more, we might be able to bring Mars and the other nearer planets of the solar system to such seeming nearness as to ascertain definitely whether they are inhabited or not.

One possibility, worth mentioning in conclusion, is that electricity, when obtainable cheaply in unlimited quantities, may be utilized on a large scale to produce ozone for sterilizing milk and even the water supply of cities. Most people have noticed that after a thunderstorm there is a peculiar smell in the air. It is the smell of ozone, which is electrified oxygen. Ozone is the most effective of all germ killers, and is easily produced artificially by electrical discharges. There is even a possibility that the sick in hospitals may be cured by loading the atmosphere of the wards with enough ozone to kill all the mischievous microbes on the premises.

OLD GLORY'S FIRST BATTLE

From a Painting by H. A. OGDEN



Lafayette Holding the Line at Birmingham Meeting House at the Battle of Brandywine, in September, 1777.